

NON-PUBLIC?: N
ACCESSION #: 9310260357
LICENSEE EVENT REPORT (LER)

FACILITY NAME: SEABROOK STATION PAGE: 1 OF 4

DOCKET NUMBER: 05000443

TITLE: AUTOMATIC REACTOR TRIP DUE TO MAIN GENERATOR EXCITER
BRUSH FAILURE
EVENT DATE: 09/22/93 LER #: 93-18-00 REPORT DATE: 10/22/93

OTHER FACILITIES INVOLVED: DOCKET NO: 05000

OPERATING MODE: 1 POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR
SECTION:
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
NAME: Mr. James M. Peschel, TELEPHONE: (603) 474-9521
Regulatory Compliance Manager ext 3772

COMPONENT FAILURE DESCRIPTION:
CAUSE: X SYSTEM: TL COMPONENT: EXC MANUFACTURER: G080
B SJ RV D243
B SJ PSX X000
REPORTABLE NPRDS: Y
Y
Y

SUPPLEMENTAL REPORT EXPECTED: No

ABSTRACT:

On September 22, 1993, at 0521 EDT, an automatic reactor trip from 100 percent power occurred. This trip was initiated by a reactor coolant pump (RCP) undervoltage reactor trip signal, which was caused by degradation of the main generator TL! rotor field. Primary plant response was normal with expected Engineered Safety Feature (ESF) actuations. This event was reported to the NRC at 0638 EDT on September 22, 1993 as an immediate notification pursuant to 10CFR50.72(b)(2)(ii), actuation of the Reactor Protection System (RPS) and Engineered Safety Feature (ESF) System.

The voltage and current used to develop the magnetic field on the main generator rotor are supplied by a synchronous alternating current exciter directly coupled to the main rotor shaft. The magnitude of the exciter output voltage controlled by varying the exciter field strength. This is accomplished by applying a direct current voltage to two collector rings located on one end of the exciter rotor through six graphite brushes.

The cause of the loss of main generator rotor field was the degradation of the exciter output voltage due to arcing at the exciter brush/collector ring interface. This arcing eventually caused a degradation of electrical contact between the brushes and the collector ring, which led to a degrading exciter field. The degrading exciter field in turn resulted in a degrading main generator field and the Station undervoltage conditions that generated the RCP undervoltage reactor trip signal.

There were no adverse safety consequences as a result of this event.

END OF ABSTRACT

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Description of Event

On September 22, 1993, at 0521 EDT, an automatic reactor trip from 100 percent power occurred. This trip was initiated by a reactor coolant pump (RCP) undervoltage reactor trip signal, which was caused by degradation of the main generator rotor field.

Seabrook Station has a main generator rated at 1350 MVA and 25kV which was manufactured by General Electric. The voltage used to produce a magnetic field on the generator rotor is supplied by a synchronous alternating current exciter, which is directly coupled to the main generator shaft. The exciter output, in addition to producing the main generator rotor field, is used to produce the exciter field through a rectification and voltage regulation system. This voltage is supplied to the exciter rotor through two collector rings and six graphite brushes (three brushes per collector ring). The brushes were mounted in individual holders and held in position by variable pressure retaining springs.

On September 22, 1993, arcing occurred between the inner collector ring and its associated brushes. This arcing caused a degradation and eventual loss of electrical contact between the brushes and the inner collector ring. As the electrical contact was being lost, the exciter field degraded, resulting in a reduced exciter output voltage and a degrading magnetic field on the rotor of the main generator. The degradation of the main generator rotor field caused a Station undervoltage transient, which

initiated a reactor coolant pump undervoltage reactor trip signal that caused reactor trip breakers to open. Subsequent to the trip, a turbine trip reactor trip signal and a reactor coolant pump underfrequency reactor trip signal were generated.

The arcing caused significant damage to the exciter. The inboard brushes were destroyed, and the inboard collector ring was severely pitted. There was also damage to the exciter rotor shaft and to the insulation between the collector ring and the rotor shaft.

The response to the reactor trip and the subsequent recovery actions by plant operator were determined to be correct. Primary plant response was normal with expected Engineered Safety Feature (ESF) actuations (Emergency Feedwater System (EFW) BA! actuation on Steam Generator LO-LO level and Feedwater System SJ! Isolation in response to low Reactor Coolant System temperature). However, during the secondary plant response, the piping welds on the inlet of the 26A and 26B feedwater heater relief valves (1-MVD-V121 and 1-MVD-V132) failed, and the bellows in 1-MVD-V121 failed. These failures did not adversely affect the response of the plant to the reactor trip. The valve and weld failures were repaired prior to plant startup. A design change to the piping to 1-MVD-V121 and 1-MVD-V132 was implemented that is expected to prevent the failure of these welds in the future.

Arcing between the exciter collector ring and brushes has existed during this operating cycle. Checks for arcing and brush bouncing were performed daily, with more extensive inspections, cleaning and brush adjustments performed weekly, as recommended in the vendor manual. The design and materials used in the Seabrook collector design are not unique and are used in other General Electric turbine generators. A review of operating experience revealed only one similar event at another licensee. However, unlike this event, that case was due to inadequate preventive maintenance.

At 0638 EDT on September 22, 1993 North Atlantic made a four-hour notification to the NRC pursuant to 10CFR50.72(b)(2)(ii).

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Safety Consequences

There were no adverse safety consequences as a result of this event. Plant equipment functioned as designed in response to the reactor trip, and operator actions were determined to be correct. At no time during the event was there any adverse impact on the health and safety of plant employees or the public.

Root Cause

The root cause of this event was determined to be significant arcing between the inner exciter collector ring and its associated brushes due to inadequate electrical contact. The cause of the inadequate electrical contact has been determined to be a result of a combination of interacting conditions within the excitation system which developed in the months preceding the event. These conditions are:

- a reduction in contact pressure for one brush compared to that for the other brushes electrically in parallel, due to variable spring tension,
- brush vibration caused by shaft spin unbalance and collector ring surface roughness,
- contamination present on the collector ring or brushes, most likely in the form of oil misting from the exciter bearing or carbon dust, which was produced in greater than normal amounts due to the frequency of brush tightening in attempts to minimize arcing.

Corrective Actions

The exciter brush rigging housing was replaced with an improved rigging housing consisting of constant pressure brushes. The rotor, including the collector rings, was replaced. The exciter field breaker and exciter rectifier assembly were tested to ensure they were not damaged during the undervoltage transient.

The following additional actions are being taken:

- 1 . The preventive maintenance process will be revised to provide additional guidance on the minimization of oil misting from the exciter bearing.
2. The use of a brush rigging assembly consisting of four constant brushes instead of three, as is currently used, will be evaluated to determine if using four brushes will reduce the possibility of arcing.
3. Additional controls and monitoring will be developed for collector ring arc management.

Plant Conditions

At the time of this event, the plant was in Mode 1, at 100 percent power.

Related Events

This is the first event of this type at Seabrook Station.

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Ted C. Feigenbaum
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NYN- 93144

October 22, 1993

United States Nuclear Regulatory Commission
Washington, D.C. 20555

Attention: Document Control Desk

Reference: Facility Operating License No. NPF-86, Docket No. 50-443

Subject: Licensee Event Report (LER) No. 93-018-00: Automatic
Reactor Trip Due to Main Generator Exciter Brush Failure

Gentlemen:

Enclosed please find Licensee Event Report (LER) No. 93-018-00 for Seabrook Station. This submittal documents an event which was discovered on September 22, 1993. This event is being reported pursuant to 10CFR50.73(a)(2)(iv).

Should you require further information regarding this matter, please contact Mr. James M. Peschel, Regulatory Compliance Manager, at (603) 474-9521, extension 3772.

Very truly yours,

Ted C. Feigenbaum

TCF:MJM/act

Enclosures: NRC Forms 366, 366A

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United States Nuclear Regulatory Commission
Attention: Document Control Desk

October 22, 1993

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